

**Assessing flux from wetland soils and
sediments: Demonstration of a method to
quantify dissolved organic carbon, oxygen,
and contaminant fluxes across the
sediment–water interface in restored tidal
wetland soils in the Sacramento San Joaquin
Delta and Estuary.**

Emmanuel S Boss

Public Comments

No public comments were received for this proposal.

Initial Selection Panel Review

Proposal Title

#0250: Assessing flux from wetland soils and sediments: Demonstration of a method to quantify dissolved organic carbon, oxygen, and contaminant fluxes across the sediment–water interface in restored tidal wetland soils in the Sacramento San Joaquin Delta and Estuary.

Funding:

Do not fund

Initial Selection Panel (Primary) Review

Topic Areas

- Processes Controlling Delta Water Quality
- Assessment And Monitoring

Please describe the relevance and strategic importance of this proposal in the context of this PSP. How does the proposal address the topic areas identified above? What are the broader CALFED Goals this proposal may meet that are not accounted for in these specific topic areas?

Proposal No. 250 Assessing flux from wetland soils and sediments: Demonstration of a method to quantify dissolved organic carbon, oxygen, and contaminant fluxes across the sediment–water interface in restored tidal wetland soils in the Sacramento San Joaquin Delta and Estuary. This proposal was rated 'above average' in technical quality and 'adequate' in collaboration. The proposal seeks Phase I funding (\$360,000) to test a novel way of estimating how much dissolved organic matter (DOM) leaches from channel bottoms in the Delta. How much DOM these 'soils' exude per square foot per day is the 'flux' referred to throughout the document. Like tea from a steeping tea-bag, the DOM emanating from channel beds is brown. The browner this stained water, the higher its DOM concentration. The applicants hypothesize that

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Initial Selection Panel Review

measuring near-bottom water color intensity and turbulence (with an 'autonomous sensors package') will be a faster, less invasive way to estimate benthic DOM fluxes than the current method of deploying glass chambers over small patches of the bed. At the low DOM concentrations that prevail in most of the Delta under existing conditions (

The budgets of proposals submitted in response to this PSP are larger, on average, than those submitted to CALFED in previous years. The Science Program is committed to getting as much science per dollar as is reasonably possible. With this commitment in mind, can the proposed budget be streamlined? If so, please recommend and clearly justify a new budget total in the space provided.

Evaluation Summary And Rating.

Provide a brief explanation of your summary rating and any additional comments you feel are pertinent.

Selection Panel (Discussion) Review

fund this amount: \$0

note:

do not fund

This proposal would develop a new technique to complement or replace chamber methods for estimating DOC flux from sediments. The Panel agreed that DOC is an issue with drinking water quality implications, but does not think this proposal will add significant new information on how DOC will leach from flooded farmland or successfully estimate how much DOC a newly flooded tract of land generates.

The Panel felt that compared to other proposals, this work fell more along the lines of pure research - it was not clear how this would be extrapolated into management decisions about restoration projects.

Panel Ranking: Do not fund.

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Collaboration Panel Review

Proposal Title

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Final Panel Rating
adequate

Collaboration Panel (Primary) Review

Collaboration:

Will the results of the collaborative effort be greater than the sum of its parts? Is it clear why the subprojects are part of a larger collaborative proposal rather than several independent smaller ones?

This is a collaboration between University of Maine, USGS, and USC that tests different methodologies for estimating carbon flux. The collaboration includes the right mix of tasks.

Interdependence And Integration:

Does the proposal have an example that clearly articulates the conceptual model of each subproject and how they link together as a whole? Are the boundaries of the study plans focused and cohesive, yet well delineated? Is there a plan for potential differences in the stages of subproject completion times? Are there clear plans for analyses and interpretations which seek to identify and quantify relationships among the data collected in various subprojects rather than separate analyses for each subproject?

The integration is fairly straightforward. It's not totally clear how the measurements between the two methods will be compared.

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Collaboration Panel Review

Project Management:

Is it clear who will be performing management tasks and administration of the project? Are there resources set aside for project management and time given for investigators to collaborate? Is there a process for making decisions during the course of the project? Are there acknowledgments of potential barriers to collaboration and explanations of how team members will overcome barriers particular to their institutions?

Monthly conference calls and 1 on site meeting proposed. The budget is not presented in an integrated manner. There is no discussion of potential difficult items. The team has demonstrated the ability to work together with some preliminary data. Specific duties of co-PIs are well-defined.

Team Composition:

Does the lead principal investigator have successful management history and experience leading collaborative teams? Is it clear that all key personnel are committed to making significant contributions to the project? Do team members have complementary skills?

The team includes a mix of methodology-specific expertise and local expertise. They have demonstrated significant expertise through publications.

Communication Of Results:

Is there a clear plan for comprehensive and cohesive reporting of project progress to the CALFED community?

The reporting is rather pro-forma. One peer-reviewed paper for a \$362K grant.

Additional Comments:

Collaboration Panel (Discussion) Review

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Collaboration Panel Review

Primary reviewer felt that good collaboration was planned with outside organizations, but that a thorough description of the integration of how methods are compared is lacking. The plan for communication of results is not well defined.

Secondary reviewer preferred to have tasks integrated during the project and not just at the end. Project management PI had no time or funds allotted for management, although the task leads did have those categories identified. Secondary reviewer agreed with the Primary regarding communication deficiency.

Technical Synthesis Panel Review

Proposal Title

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Final Panel Rating
above average

Technical Synthesis Panel (Primary) Review

TSP Primary Reviewer's Evaluation Summary And Rating:

The overall idea of this proposal is use of the non-invasive autonomous physical and optical sensor package to quantify sediment–water fluxes. With this approach, data can be collected over longer time periods and easily be performed at multiple sites so that with the eddy correlation technique, benthic fluxes can be calculated much more extensively than is possible with placement of benthic chambers. This includes use in sediment types where benthic chambers will not work. This is very good. However, a main justification for the study is that the fluxes of dissolved organic carbon (DOC) is important for both ecosystem trophic dynamics and ecosystem and human health. Here, I find the proposed research is not consistent with the background justification. I am uncomfortable with the claims that the CDOM sensor is sensitive enough to measure a fluctuation representing 0.1 μM DOC since direct DOC analysis is not that sensitive. To me this is somewhat analogous to indicating that a calculator can give many significant figures, even if they do not mean anything. In addition, the correlation between CDOM and DOC, as shown with Figure 2 would not allow interpretation at that level of fluctuation; do they mean 0.1 mg/L? I think that another interpretation of Figure 2

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Technical Synthesis Panel Review

is that the correlation of CDOM to DOC is only fairly good (a correlation with r^2 of 0.95 is not great for analytical chemistry calibration - usually too poor for such use). This is especially important if very small fluxes are significant for ecological purposes. Both external reviewers appear to accept on face value the assumption that CDOM is a good proxy for DOC. I do not feel that it is as good of a proxy as claimed and also question if this is even the correct assumption. The real interest is correlation to "active" DOC, that material that might be important to contaminant problems and for trophic dynamics. Some of the contaminant problems are discussed in the background material including methyl mercury and potential for formation of disinfectant byproducts (DBPs). Also, if DOC from sediment fluxes is important in heterotrophic metabolism, it is important to discriminate between labile and refractory material. I think that direct comparison of specific organic analyses from benthic flux chambers with the CDOM signals would be a much more valuable contribution than using CDOM-DOC correlation. A lot of effort has been made in recent years to measure and study CDOM in surface aquatic waters. It is very clear from such research, that the optically active portion of the DOC pool is a highly variable and small portion of the total pool. To me, a crude correlation between CDOM and total DOC is a misleading indication of success for the intended purposes. Overall, I feel that this weakness shows a lack of good linkage between the goals, justification, and approach of the proposed project.

Additional Comments:

The overall idea of this proposal is use of the non-invasive autonomous physical and optical sensor package to quantify sediment-water fluxes. With this approach, data can be collected over longer time periods and easily be performed at multiple sites so that with the eddy correlation technique, benthic fluxes can be calculated much more extensively than is possible with placement of benthic chambers. This includes use in sediment types where benthic chambers will not work. This is very good. However, a main justification for the study is

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Technical Synthesis Panel (Discussion) Review

TSP Observations, Findings And Recommendations:

This was a well-written proposal that addresses important questions. A particular strength of this proposal was the use of a remote, non-invasive method that would readily allow large numbers of measurements to be made. While the ability for rapid measurements of sediment water fluxes is viewed as very attractive, there were criticisms of the CDOM sensor and other aspects of the proposal. Specifically, the idea that physical fluxes are representative of contaminants was questioned. It was also questioned whether the vertical resolution of the velocity profiles would be sufficient to resolve boundary layers and profile gradients needed for accurate use of the eddy equation. Many of these concerns were detailed in the primary reviewer's evaluation.

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Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	<p>There are three goals proposed for the project, which are clearly stated in the executive summary: (1) demonstrate a new, non-invasive method to quantify dissolved organic carbon and dissolved oxygen fluxes across the sediment-water interface, (2) assemble the first record of these fluxes at five sites within the tidal reaches of the Sacramento-San Joaquin Delta and Estuary (3) use fluxes and analyses of biogeochemical samples obtained from the first two goals to constrain contaminant fluxes at the sediment-water interface.</p> <p>The concept is timely and important, and the proposal is responsive to the CALFED Science Program priority topics. The proposed research is aligned with priority topic (iii), Performance Assessment to Improve Tools and Evaluate Implications of Future Changes, and addresses the programmatic goals for new monitoring approaches that will benefit future management of the Bay - Delta system. A successful deployment of the proposed technology creates a significant opportunity for streamlining and reducing the costs of monitoring, and appears worthy of consideration. The results of this project will allow more explicit description of transport associated with nutrient source terms in larger-scale models.</p>
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The research proposed in the first two goals of the proposal also meets needs for the two other Science Program priority topic areas: For topic (i): Water Operations and Biological Resources, the project will supply data and information on nutrient availability for heterotrophic organisms, and the environmental processes affecting carbon and oxygen flux in the tidal reaches of the Delta-Estuary system.

For topic (ii), Ecological Processes and Their Relationship to Water Management and Key Species Conservation, the project will provide data on the benthic boundary layer processes controlling the flux and concentrations of organic carbon and dissolved oxygen in restored areas. Understanding of these processes is fundamental to unraveling the more complex ecological relationships in these zones.

The focus of the proposal is the adaptation of the non-invasive ADV (acoustic Doppler velocimeter), which measures 3D water velocities in the turbulent part of the benthic boundary layer, with micro-electrodes for dissolved oxygen and an optical fluorometer for colored dissolved material (CDM) (a method for quick estimation of dissolved organic carbon (DOC)) to monitor fluxes across two different kinds of sediment-water interfaces (sand and mud). The research will provide a calibration and comparison of the results obtained with the non-invasive technique in the water column above the sediment-water interface, to results obtained by a traditional use of benthic chambers emplaced across the sediment-water interface. Because benthic chambers are limited in range to fine-grained sediments, successful deployment of the non-invasive techniques will extend our ability to understand flux across a wider range of sediment-water interfaces. This is an important contribution for the proposed research.

The results of the first two objectives allow a quantification of the eddy-correlation method for

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	<p>computing vertical fluxes across the sediment-water interface. A valuable uncertainty analysis for fluxes computed by the eddy-correlation approach will be made, using the sensor data. These results are a significant and valuable contribution to near-shore marine sensor technology, monitoring approaches for the Bay -Delta system, and an enhanced understanding of the complex biogeochemistry of organic carbon in the system.</p> <p>The third goal of the proposal is to use the relationships determined in the first two goals to constrain contaminant fluxes across the sediment-water interface. This goal is the least well-developed in the proposal and would allow only a qualitative sense of contaminant flux (please see more detailed assessment provided in "Approach section" of this review.)</p> <p>While there are no hypotheses stated directly, they can be inferred from the goals and objectives found on pages 7, 8, and 9. It is hypothesized that the data collected through non-invasive deployment of the ADV, dissolved O₂ electrode, and CDM fluorometer will be amenable to analysis via the eddy-correlation method and will provide quick, accurate information on CDM (as proxy for DOC) and oxygen fluxes from bottom sediments. It is hypothesized that the flux data collected with the new technique will be comparable in accuracy to data obtained with benthic chambers. It is further hypothesized that a wider variety of sediment-water interfaces can be examined using these techniques than those available for study with benthic chambers.</p> <p>For the flux of DOC and oxygen, important nutrient sources in the Bay - Delta, the approach is likely to yield valuable improvements in monitoring, and thus can be considered timely and important.</p>
Rating	excellent

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Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

Comments	<p>The principal investigators have chosen to conduct the study as research, which is appropriate and justified by the development of a new method to determine the CDM fluxes across the sediment-water interface. (A pilot-scale project, demonstration-scale project, or full-scale implementation project would not be appropriate for this study, as it is aimed at developing new technologies and sensor deployment strategies.)</p> <p>The research is well-justified relative to existing knowledge of the Bay - Delta system, and the processes affecting concentrations of DOC and dissolved oxygen near-shore marine environments. Likewise, there is an extensive literature review of benthic chambers as a long-accepted approach for measuring fluxes of these constituents.</p> <p>This proposal is a creative extension of work recently published by Peter Berg and colleagues. Berg et al. (2003) used the eddy-correlation approach to determine dissolved oxygen fluxes from vertical velocities measured via ADV and dissolved oxygen concentrations measured with an electrode. They then compared these fluxes with fluxes determined using benthic chambers.</p> <p>A new aspect of the proposed study is to add a CDM fluorometer to the instrumentation package currently consisting of ADV and oxygen electrode. The CDM data will be used to assess DOC, and to calibrate sensor responsiveness. The current proposal capably addresses several research questions that arise around adapting the CDM sensor, including aspects of sensor deployment, spectral deconvolution, and associated uncertainties.</p>
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	<p>An important feature of the proposed research is the acquisition of data for five new sites in the Bay - Delta system. The investigators are knowledgeable about the Bay - Delta system and have presented a thorough discussion of the carbon flux in and out of the system, the multiple sources for DOC, and the possibility of enhanced DOC flux from sediments in restored wetlands associated with the Bay - Delta system.</p> <p>The investigators are also knowledgeable about the mathematical basis for the eddy-correlation method, and have a background in working with optical spectroscopic methods for non-invasive analyses. Likewise, the investigators have almost 20 years experience with benthic chambers.</p> <p>There are three senior PIs on the proposal; each has provided a detailed and comprehensive conceptual model for the piece of work they will be doing. The integration of the individual pieces into a comprehensive whole appears to be in the beginning phases; the proposal does acknowledge the importance of integration and communication (proposal, p. 13.) There is an implicit overarching conceptual model presented in the proposal; it is not described explicitly in the proposal, so the reader is left to put it together from the pieces presented. This is an area where communication can be improved; the technical foundation seems solid.</p> <p>Citations: P. Berg, H. Roy, F. Janssen, V. Meyer, B. Jorgensen, M. Huettel, D. deBeer (2003). Oxygen uptake by aquatic sediments measured with a novel non-invasive eddy-correlation technique. Marine Ecology Progress Series: 261 (75-83).</p>
Rating	excellent

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	<p>The proposed approach is creative, well-designed, and appropriate to meeting two of the three stated objectives. It would be useful if the proposal had included more information to allow determination of the degree to which the research would meet the third objective (see below).</p> <p>The investigators have presented a well-documented and well-justified approach for achieving the first two objectives: (1) demonstrating a new, non-invasive method to quantify dissolved organic carbon and dissolved oxygen fluxes across the sediment-water interface, and (2) assembling the first record of these fluxes at five sites within the tidal reaches of the Sacramento-San Joaquin Delta and Estuary.</p> <p>As part of the first objective, the investigators will demonstrate that the CDM fluorometer is sufficiently sensitive and responsive at time scales similar to the ADV and the dissolved O₂ electrode; the investigators have conducted preliminary tests that suggest it is (proposal text, p. 10) and have consulted with Peter Berg as well. The investigators have justified the use of colored dissolved matter (CDM) as an appropriate proxy for dissolved organic carbon (DOC) adequately through reference and by presenting some of their own preliminary results (proposal text, pages 2, 10), with the caveat that more calibration is needed because the relationship between CDM and DOC is likely to be site-specific.</p> <p>The work here extends the work of the Berg group in that it appears the investigators propose to develop a sensor package that can be suspended from above into</p>
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the benthic boundary layer (proposal text, p. ; in the study of Berg et al. (2003), the sensors were in a rack placed on the sediment bottom.

It is proposed to use an eddy-correlation mathematical model to calculate DOC and dissolved O₂ fluxes from the velocity and concentration data. Atmospheric scientists use such an approach to examine gaseous/vapor exchanges across atmospheric boundary layers. Recently, Berg et al. (2003) published their results confirming the success of the eddy-correlation model to fit data collected from ADV and a dissolved oxygen electrode in the benthic boundary layer. An equation coupling advective transport with molecular diffusion was used to model vertical oxygen flux. Molecular diffusivity was assumed to be zero for a turbulent advective environment. Berg demonstrated that this assumption works for dissolved oxygen; the proposed research, when successful, will demonstrate its success for CDM as a proxy for DOC.

During this research, water samples will be collected to corroborate the concentration data measured with the sensor package. Flux data will be collected via benthic chambers for further calibration of the technique.

For the second objective, the new sensor configurations will be deployed and tested at low and high tide for five different restored wetland sites for which some limited chemical data are available (a table describing the sites is provided on page 11 of the proposal; a map would have been helpful.) Discrete water samples also will be collected, and at three of the sites where the sediments are sufficiently fine-grained, benthic chambers will be deployed. The approach is feasible and the results will add to existing knowledge, by providing an assessment of the temporal and spatial variability of the CDM and dissolved oxygen fluxes in tidal areas near restored wetlands.

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The data collected as part of the first two goals will be of use to decision-makers in evaluating the effect of carbon flux from restored lands on nutrient availability in the Bay - Delta system. A successful deployment of the monitoring system could eventually provide a method for more extensive and less costly monitoring, especially if a general relationship between CDM and DOC could be determined. The technique for determining flux also will apply to flux from sediment-water interfaces with a wider range of sediment permeabilities (sands, muds, peats) than those currently measured by benthic chambers (muds).

There was not enough information to determine how well the research would achieve the third objective: (3) use the fluxes measured by the sensors and the biogeochemical samples to constrain contaminant fluxes at the sediment-water interface. While the approach could provide a qualitative sense of contaminant flux, there are some questions that deserve consideration.

The investigators suggest that the eddy-correlation model can be extended to an assessment of contaminant fluxes, by following the approach of the atmospheric sciences, and making the assumption that the diffusion coefficient for solutes is the same as momentum (proposal text, p. 6, para.4). They quote sources showing the assumption seems to work for gas flux across atmospheric boundary layers (proposal text, p. 6, last para.).

While Boudreau (2001) also assumes the equality of momentum and solute diffusion coefficients, in the same article he also points out the need to consider diffusivity in the case of solutes with second-order and higher rate constants. There is not enough information to determine whether the investigators are taking reactivity of contaminant species into account. It would be useful to see a some discussion of the diffusive term when modeling water (more viscous than the atmosphere), and reactive contaminant species.

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It would be helpful to know which contaminants were to be modeled for the third goal. In the executive summary, mercury, methyl mercury, and pesticides are mentioned as possibilities; in the proposal section on objectives (proposal text, p. 7), mercury and methyl mercury are given as examples. A weakness in the third goal is that a conceptual model of contaminant biogeochemistry is not provided for the contaminants chosen for flux calculations. The eddy-correlation method may not be relevant to certain kinds of reactive species.

For example, if mercury and methyl mercury are the contaminants of interest in this proposal, the investigators may want to consider some of the following complexities of mercury biogeochemistry. As indicated in the recent report, "Mercury Strategy for the Bay - Delta Ecosystem: A Unifying Framework for Science, Adaptive Management, and Ecological Restoration," (Wiener et al, 2003), biogeochemical processes affecting mercury cycling in different parts of the ecosystem are just now being studied. For the areas of interest to the research proposed here, i.e. restored wetlands, it is assumed that mercury will be reactive at oxic-anoxic sediment-water interfaces (Wiener et al., 2003). The production of soluble and bioavailable methyl mercury from inorganic sources of mercury by microbial populations at such interfaces is of concern, so it would be helpful to know the order of the rate constants for these reactions.

Likewise, in tidally active zones that will be studied as part of this project, another source of mercury for methylation is atmospherically deposited mercury. While mercury from the atmospheric source is not as prevalent as allochthonous mercury from riverine sources, its reactivity may involve non-linear kinetics. Laboratory studies examining the reduction and photoreduction of dissolved mercury in the presence of humic acid complexes in seawater have found evidence for second-order rate constants (Costa

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and Liss, 2000; Amyot et al., 1994.) Recent studies of the oxidation of elemental mercury in the dark near sediment-water interfaces indicate first-order rate constants (Amyot et al., 2005.) Because of the numerous sources and species of mercury at the sediment-water interface and in the water column in the restored wetland environments, it seems important that a more detailed conceptual model for the behavior of mercury be provided.

The proposal does allude to the possible effects of DOC on the speciation and binding of methyl mercury (proposal text, p. 3). If mercury and methyl mercury are the contaminants of interest, it would be useful to extend the proposal's current conceptual model to a more detailed discussion of possible reactions and rates involving mercury to justify modeling its flux via the eddy-correlation approach.

Also, the approach would be stronger if a list of analytes for the laboratory analyses of the discrete water samples was provided. Given the literature review and the interests of the investigators, it can be inferred that detailed spectrometry and even isotopic analyses of DOC are to be performed. It was not clear if mercury and methyl mercury are to be measured directly in water or via the benthic chambers, to be able to confirm the estimates of contaminant flux. Thus it is difficult to assess how extensive the new knowledge produced by the third objective will be.

Citations: M. Amyot, F. Morel, and P. Ariya (2005). Dark oxidation of dissolved and liquid elemental mercury in aquatic environments. *Environmental Science and Technology*: 39 (110-114).

M. Amyot, G. Mierle, D. Lean, D. McQueen (1994). Sunlight-induced formation of dissolved gaseous mercury in lake waters. *Environmental Science and Technology*: 28 (2366 - 2371).

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	<p>P. Berg, H. Roy, F. Janssen, V. Meyer, B. Jorgensen, M. Huettel, D. deBeer (2003). Oxygen uptake by aquatic sediments measured with a novel non-invasive eddy-correlation technique. Marine Ecology Progress Series: 261 (75-83).</p> <p>B. Boudreau (2001) Solute transport above the sediment-water interface, in The Benthic Boundary Layer, B. Boudreau and B. Jorgensen, editors. Oxford University Press: Ch. 5 (104-126).</p> <p>M. Costa and P. Liss (2000). Photoreduction and evolution of mercury from seawater. Science of the Total Environment: 261 (125-135.)</p> <p>J. Wiener, C. Gilmour, and D. Krabbenhoft (2003). Mercury strategy for the Bay - Delta Ecosystem: A Unifying Framework for Science, Adaptative Management, and Ecological Restoration, Report to the California Bay Delta Authority, 59 pages.</p>
Rating	very good

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success?
 Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	<p>The approach for the first two goals is well-documented and technically feasible, as evidenced by the recent success of the work of Berg et al. (2003) and the preliminary tests (proposal text, p. 10) of the responsiveness of the CDM fluorometer. The investigators are very likely to be successful in the ADV, CDM, and dissolved oxygen measurements and the flux calculations. There are important contributions being made in designing the equipment to include the CDM sensor with the ADV and the dissolved oxygen sensors (proposal text, p. 9). Likewise, there will be good contributions made in assessing the uncertainty of such sensors operating in turbulent environments.</p>
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	<p>The investigators have extensive background in much of the kind of research (optical sensor development, DOC biogeochemistry, eddy-correlation modeling, flux measurement with benthic chambers) proposed here.</p> <p>There were some inconsistencies in the descriptions of the roles of the some scientific staff that require clarification. Drs. Boss, Bergamaschi, and Bertelson are listed as the principal investigators (and as "primary staff" in the CALFED proposal form) from the University of Maine, USGS, and University of S. California, respectively. It is clear that Dr. Boss is the coordinating principal investigator and team leader for the group. There are two more junior personnel (Dr. T. Bergman, University of Maine, and B. Downing, USGS) who are mentioned in the proposal text (p. 12) in a way to suggest they are considered principal investigators. In the CALFED personnel forms accompanying the proposal, they are listed as "secondary staff." In the case of Dr. T. Bergman, it would have been useful to have seen a copy of her CV, as it appears from the task information, that she will be responsible, along with B. Downing, for the development, adaptation, and deployment of the sensor package, and the data analysis and interpretation. Downing's CV was provided and indicates experience with the electronics that increases the feasibility of CDM sensor development/adaptation. It would be helpful to see Dr. Bergman's experience in these areas. The adaptation of the sensors appears to involve changing the deployment schema from that used by Berg (stationary rack placed on sediment bottom) to an instrumentation package suspended from a boat (proposal text, p. 8-9), so this task is an important one.</p>
Rating	very good

Monitoring

If applicable, is monitoring appropriately designed (pre–post comparisons; treatment–control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	<p>While the overall focus of the research is more on the development of new sensor technology, than the performance of monitoring, a portion of the project will do short-term (2–3 week) monitoring of carbon and oxygen fluxes across the sediment–water interface in tidal zones.</p> <p>This set of experiments is designed to test a new technique for non-invasive monitoring of CDM, a proxy for DOC. While data will be collected from several sites of different physicochemical characteristics, the data are being used primarily to demonstrate sensor efficacy and modeling capability, rather than to perform detailed interpretation and biogeochemical analyses. The monitoring is well-designed for this purpose. The intent is that a successful deployment of the ADV, sensors, and eddy-correlation calculations will provide a new, rapid technique for wide-scale monitoring in the future.</p> <p>The design of the experiments allows the comparisons between two distinct types of measurements: (1) velocities and calculated concentration profiles for CDM and dissolved oxygen via non-invasive sensor deployment, and (2) flux measurements using benthic chambers that span the sediment–water interface. In essence, the benthic chambers are being used as control / comparison for the data collected non-invasively. Also, discrete water analyses are being collected to validate the concentration profiles calculated with the eddy-correlation approach. The list of analytes are not provided so it is not possible to estimate the extent of interpretations that will be made for the water chemistry data.</p>
Rating	very good

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Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	<p>Successful development of the technology in this proposal will be of great value to the objectives of CALFED. Three types of products will be immediately forthcoming: (1) A sensor package for rapid assessment of CDM and dissolved oxygen concentration profiles and fluxes that is less costly than existing methods for attaining such information (2) A set of deployment strategies for the sensor package to allow optimal placement in areas of different sediment bottom and different tidal effects (3) Additional validation of the eddy-correlation method for calculating flux in marine turbulent layers</p> <p>The sensors and deployment strategies developed through this research will be very useful to monitoring the concentrations of CDM and dissolved oxygen around the Bay - Delta system. The technique may prove easier and more cost-effective than current monitoring approaches, and allow a denser sampling scheme to be developed.</p> <p>It is clear that the principal investigators have extensive experience in interpreting optical sensor data and the biogeochemistry of organic carbon in this environment. As part of the second project objective, the team will use the sensor array to examine the in-situ temporal and spatial variability of the flux of CDM and dissolved oxygen. This aspect of the work will extend interpretations of nutrient availability in the Bay - Delta system. The USGS personnel are involved in several other funded projects to examine the kinds of processes affecting carbon in the Bay - Delta, and it is likely that the complementary information developed by this research will allow additional interpretative outcomes to be achieved. The</p>
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#0250: Assessing flux from wetland soils and sediments: Demonstration of a me...

Technical Review #1

	research proposed here is a good leverage of funds and capabilities.
Rating	excellent

Additional Comments

Comments	<p>The technical content of the proposal is of high caliber (with need for minor clarifications, as noted above). There were numerous typographical errors through the proposal that suggested it was put together very rapidly. Likewise, it is easy to pick out which principal investigator provided each section of the proposal, suggesting that the integration of the project is still evolving.</p> <p>The proposal mentions that the investigators have consulted with Dr. Berg, at University of Virginia, who has direct experience with the equipment. If the proposal is successful in the category for multi-institutional, multi-disciplinary projects, it would be useful to suggest to the team to consider a small subcontract to Dr. Berg, for his review of the deployment plans and a possible site visit during field work.</p>
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Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	<p>The project represents a collaboration between the University of Maine, USGS, and University of S. California. The principal investigators Dr. Boss (U. Maine), Dr. Bergamaschi (USGS), and Dr. Bertelson (USC) each have extensive publication records and good track records of producing high-quality results. They come from institutions that encourage extramural research, and have a strong infrastructure.</p>
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#0250: Assessing flux from wetland soils and sediments: Demonstration of a me...

Technical Review #1

	<p>Each of the principal investigators brings necessary equipment such as an ADV, and benthic chambers(see proposal text, p. 13-14), students and support staff, and several years experience to the project. As mentioned above, it would be helpful to know more about the background of Dr. Bergman (who may be a post-doc?), who will be doing much of the sensor development and deployment.</p> <p>The one area that could use some development is the integration of the work. While Drs. Boss and Bergamaschi and their teams have done some preliminary work together already, it is not clear how extensive previous collaborations with Dr. Bertelson's research group are. This integration may already be happening; it just did not show up in the written presentation of the proposal.</p> <p>The project management plan describes monthly conference calls, and one meeting a year. It seems important that the team consider participating in the regularly scheduled CALFED Science Conferences, as well as the national scientific meetings they are planning to attend. It would also be useful to know that all the principal investigators will be in the field together for at least a few days.</p>
Rating	very good

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	The budget seems fair and adequate. Running all the work through a single university (U. Maine) allows Dr. Boss as the coordinating principal investigator and project manager to have good control on expenditures.
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#0250: Assessing flux from wetland soils and sediments: Demonstration of a me...

Technical Review #1

	<p>In the introductory material for the PSP, there was a place for the principal investigators to identify their involvement in other proposals funded by CALFED. This proposal package contained 6 different projects that appear to be funded by CALFED; there were no statements made about which principal investigator was funded or the amount of funding. It could be deduced that much of the work on the other projects was being conducted by the USGS, with some contribution from the University of Maine. However, who was receiving how much funding was not made explicit. There is likely to be good leverage with these other projects, which also focus on aspects of biogeochemistry of dissolved organic carbon in the Bay - Delta system.</p> <p>At the same time, the USGS is providing full matching funds (\$40,000) for their involvement with this project, and each institution is providing significant resources in terms of equipment. When the scientific contribution of each institution is assessed, and the funding to each institution is calculated separately, things appear fair. The numbers also demonstrate the relative cost-savings over the use of benthic chambers that a successful outcome for the sensor package will produce.</p> <p>Note, reviewer's bias follows: It seems unfortunate the university contract system works in such a way that double university overhead (Univ. of Maine 48.5%, Univ. of S. Cal. ~62%) is charged on subcontracts (up to \$25,000); it would be preferable to see more money go to the scientists for the science and less for the administration of grants and contracts.</p>
Rating	excellent

Overall

Provide a brief explanation of your summary rating.

Comments	
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#0250: Assessing flux from wetland soils and sediments: Demonstration of a me...

Technical Review #1

	<p>This proposal falls in the top third of similar kinds of proposals for new technology development. It is a very creative adaptation and application of non-invasive means of determining vertical concentration profiles for two constituents that serve as important nutrients for the Bay - Delta system. There is a strong, experienced technical team involved. Encouraging the investigators to focus on accomplishing the first two goals they have proposed is likely to assure a highly successful outcome. These two goals seem fundable with little to no modifications suggested.</p> <p>Once the eddy-correlation approach for determining flux across the sediment-water interface in turbulent zone is further validated by the successful deployment of the ADV, dissolved oxygen electrode, and CDM fluorometer, then the investigators would be justified in expanding their research. Success in the first two years would then warrant an extension in out-years of the eddy-correlation method to a study of contaminants for which a detailed conceptual model and characterization plan were developed.</p>
Rating	very good

Technical Review #2

proposal title: Assessing flux from wetland soils and sediments: Demonstration of a method to quantify dissolved organic carbon, oxygen, and contaminant fluxes across the sediment–water interface in restored tidal wetland soils in the Sacramento San Joaquin Delta and Estuary.

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	Yes to both questions. The project aims to demonstrate and verify a method for measuring the flux of organic carbon, dissolved oxygen, and contaminants between sediments in restored wetlands and the water column. This is very important both from ecological and human health perspectives.
Rating	excellent

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full–scale implementation project justified?

Comments	Yes to all of the above. The conceptual model-eddy correlation method compared with in situ benthic chambers-is well explained, and well-justified.
Rating	excellent

Technical Review #2

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	Yes to all of the above. The approach should demonstrate the feasibility of using a new and novel approach for assessing water quality impacts of restoration. The project will not only provide information on specific sites that will be useful to decision-makers, but (more importantly) will provide a method that will be widely applicable to other sites in the Delta.
Rating	excellent

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	Yes, the approach seems feasible, given the technology available to the team. Success seems highly likely. Scale is clearly consistent with objectives and within grasp of the authors.
Rating	excellent

Monitoring

If applicable, is monitoring appropriately designed (pre–post comparisons; treatment–control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	N/A
Rating	excellent

Technical Review #2

Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	The main product of the work (in addition to published papers) will be a specific methodology that can be applied in a wide variety of conditions (sediment characteristics, vegetation, tidal velocity, bed roughness, etc.) in order to assess the likely water quality impacts of a proposed restoration project. The contribution to a larger data management system will depend on diffusion of the new technology, and the breadth of its implementation. The method will be applicable beyond California.
Rating	excellent

Additional Comments

Comments	See Overall comment below
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Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	Based on their resumes, the authors are clearly qualified to undertake this project. They have the requisite field and laboratory experience, and will bring to the project equipment valued at >\$75,000. They are also experienced in the Sacramento-San Joaquin Delta.
Rating	excellent

Technical Review #2

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	Yes, the budget is detailed, and seems adequate. I cannot "second guess" specific items (e.g., "is the amount for instrument deployment adequate?"). But I do think that a project such as this could only be done for the price (\$363k) by a consortium of universities and public agencies
Rating	excellent

Overall

Provide a brief explanation of your summary rating.

Comments	This proposal addresses a critical water quality issue about which little is known. It is rare to find a proposal that is likely to yield both practical, problem-oriented results, as well high-quality and cutting-edge research that will likely be eligible for publication in a "high-end" scientific journal. In my opinion, this is exactly the kind of research project that CALFED should be funding. Overall rating: Excellent.
Rating	excellent

